REMARKS

Reconsideration is respectfully requested. Claims 1 – 15 pending. Claims 2, 3, 14, and 15 are withdrawn. Claim 1 is amended to more particularly point out features of the claimed invention.

Applicants have not dedicated or abandoned any unclaimed subject matter and moreover have not acquiesced to any rejections made by the Patent Office. Applicants reserve the right to pursue prosecution of any presently excluded claim embodiments in future continuation and/or divisional applications.

Claim Amendments

Claim 1 is amended to point out that the first and second gases are precursor gases and that radical species formed from the first and second precursor gases are formed in the reaction chamber. Support for the claim amendments are found in the specification, such as for example at page 2, line 20 to page 3, line 11; and at page 6, line 30 to page 7, line 9, among others. Applicant respectfully submits that no new matter is added by this amendment.

Claim Rejections – 35 U.S.C. §102

Claims 1, 4-6 and 10

Claims 1, 4-6 and 10 stand rejected under 35 U.S.C. §102 (a) as being anticipated by Sneh et al. (U.S. Pat. No. 6,305,314) ("*Sneh*"). Applicants respectfully traverse.

For an anticipation rejection under 35 U.S.C. § 102 to be proper, a single reference must disclose each and every element of a claim. In re Paulsen, 31 USPQ2d 1671, 1673 (Fed. Cir. 1994); M.P.E.P. § 2131 (citing Richardson v. Suzuki Motor Co., 9 USPQ2d 1913, 1920 (Fed. Cir. 1989).

Sneh does not teach a deposition method where two species of gases are introduced into a chamber and irradiated with electromagnetic irradiation to form radical species within the chamber.

Claim 1 requires:

> introducing a first precursor gas into the reaction chamber;
> initiating a first pulse of electromagnetic irradiation to form radicals species from said first precursor gas in said reaction chamber, where the radical species react

> with the surface of the substrate to form a radical terminated surface on the substrate;
> purging the reaction chamber;
> introducing a second precursor gas into the reactor; and
> initiating a second pulse of electromagnetic irradiation to form second radicals species from said second precursor gas in said chamber, where the second radical species react with the radical terminated surface to form a layer of film on the substrate.

Thus the pending claims require the introduction of two species of precursor gases into a reaction chamber and electromagnetic irradiation of the gases to form two radical species within the reaction chamber. This is not taught or suggested by *Sneh*.

The Examiner states on page 2 of the instant Office Action:

> As to claim 1, Sneh et al. discloses a first gas, creating radicals from the first gas, creating radicals from the first gas using electromagnetic radiation, purging by the vacuum (reference number 63 in the Figures – at least as it is broadly claimed and described – see instant claim 5 for example), introducing a second gas, and creating radicals from the second gas using electromagnetic radiation. See column 6, line 64-column 7 line 55, for example.

However, the passage referred to by the Examiner is related only to one of the steps of the deposition process disclosed by *Sneh,* namely Step **45**, not the entire deposition process, which is a Radical-Assisted Sequential CVD (RAS-CVD), which includes the steps of: Pulsing in a first precursor (Step **41**) -> purge (Step **43**) -> pulsing in single or multiple radical species (Step **45**). Step **41** is repeated after Step **45** without a purge step. See col. 6, ll. 43-56 and FIG. 3. It should be noted that the first steps (Step **41** and **43**) "are the same as in the convention process," col. 6, ll. 46-47, where a metal-bearing gas is introduced to the reaction chamber and reacts with the surface, col. 6, ll. 21-24. *Sneh* does not teach electromagnetic irradiation introduced to form radicals in the chamber during the first steps as recited in applications claims.

Sneh teaches that the second step, Step 45, "may be a single step involving a single radical species," col. 6, ll. 57-58, or "a compound step comprising substeps involving different radical species," col. 6, ll. 57-58. However, *Sneh* does not teach the steps of introducing two species of precursor gases into a reaction chamber to generate two species of radicals in the reaction chamber by introducing electromagnetic radiation.

Sneh discloses that radicals can be created by plasma generation, col. 7, ll. 17-20, and further discloses:

> Production of atomic species can be done in several ways, such as (1) in-situ plasma generation, (2) intra-showerhead plasma generation, and (3) external generation by a high-density remote plasma source or by other means such as UV dissociation or dissociation of metastable molecules. [R]effering again to FIG. 1, these methods and apparatus are collectively represented by apparatus **25** (emphasis added). Col. 9, ll. 42-48.

As shown in FIG. 1 of *Sneh*, apparatus **25** is located *outside* of the deposition chamber **13**. Therefore, *Sneh* discloses "atomic species" to be generated outside of the deposition chamber before being introduced into the deposition chamber. This is opposite of the claimed invention where the radical species are generated in the reaction chamber as recited in applicants amended claims.

As such, *Sneh* fails to teach or suggest each and every elements of the claimed invention. Applicants respectfully submit that the rejections on this basis are improper and should be withdrawn.

Claims 1, 1-6 and 10-13

Claims 1, 4-6 and 10-13 stand rejected under 35 U.S.C. §102 (b) as being anticipated by Heinecke et al. (4935661) ("*Heinecke*"). Applicants respectfully traverse.

The present invention is directed to energy-assisted atom layer deposition (EALD) where radicals are formed by electromagnectic irradiation within a reaction chamber. The source of electromagnectic irradiation can be radio frequency, visible light, or UV light.

In contrast *Heinecke* discloses apparatus and process for pulsed plasma treatment of a substrate surface. See col. 1, ll. 4-5. Applicant submits that the plasma of *Heinecke* is different from creating radical species of precursor gases as recited in applicants amended claims.

Heinecke further discloses that in order to generate the plasma, "a high power pulsed radio frequency field" is applied "to a region surrounding or adjacent the substrate thereby substantially fully dissociating the gas." Col. 2, ll. 13-17. This "requires at 100W/cm^3 for less stable gasses (e.g. saline), and at least 300W/cm^3 for stable gases such as nitrogen." Col.

5, ll. 41-44. Such high power pulsed radio frequency is generated with a generator of peak powers up to 40 to 50 kW. See col. 5, ll. 48-68.

Therefore *Heinecke* discloses a method of depositing film where plasma, rather than radicals, is generated.

Further, *Heinecke* does not teach or suggest reacting the first radical species react with the surface of the substrate to form a radical terminated surface on the substrate, or reacting the second radical species with the radical terminated surface to form a layer of film. As such, *Heinecke* fails to teach or suggest each and every elements of the claimed invention. Applicants respectfully submit that the rejections on this basis are improper and should be withdrawn.

Claim Rejections – 35 U.S.C. §103

Claims 7-9 and 11-13

Claims 7-9 and 11-13 stand rejected under 35 U.S.C. 103 §(a) as being unpatentable over *Sneh*. Applicants respectfully traverse.

When rejecting claims under 35 U.S.C. §103, the Examiner bears the initial burden of factually supporting any *prima facie* conclusion of obviousness. MPEP § 2142. The inquiry of obviousness is controlled by the *Graham* factors. See *KSR International Co. v. Teleflex Inc.* 1727 S.C.t (2007) (citing *Graham v. John Deere Co. of Kansas City*, 383 U.S. 1 (1966)). These factors are: 1) the scope and content of the prior art; 2) the differences between the prior art and the claims; 3) the level of ordinary skill in the pertinent art; and 4) objective evidence of nonobviousness.

As presented above, *Sneh* does not teach a deposition method where two species of precursor gases are introduced into a chamber and irradiated with electromagnetic irradiation to form radical species within the chamber.

Moreover, *Sneh* in fact teaches way from the claimed invention.

"[W]hen the prior art teaches away from combining certain known elements, discovery of a successful means of combining them is more likely to be nonobvious." *KSR*, at 1740. "[A] reference may teach away when a person skilled in the art, upon reading the reference, would be discouraged from following the path set out in the reference, or would be led in a direction divergent from the path that was taken by the applicant." *In re ICON*, at 1751.

Sneh discloses in col. 9, ll. 53-58 that:

> The preferable method at the time of this specification is remote generation by a high-density source, as this is the most versatile method. The radicals are generated in a remote source and delivered to the ALD volume, distributed by a showerhead over the wafer in process (emphasis added).

Therefore a skilled artisan, upon reading *Sneh*, would be led to generate radical remotely from the reaction chamber and then delivering the radicals into the reaction chamber, and would be discouraged from following the method of the claimed invention which requires the generation of radicals within the reaction chamber. Thus, *Sneh* teaches way from the claimed invention.

Accordingly, because *Sneh* does not teach a deposition method where two species of precursor gases are introduced into a chamber and irradiated with electromagnetic irradiation to form radical species within the chamber, and actually teaches away from claimed invention, applicants submit that a *prima facie* case of obviousness is not established. Applicants respectfully submit that the rejections on this basis are improper and should be withdrawn.

Claims 7-9

Claims 7-9 stand rejected under 35 U.S.C. 103(a) as being unpatentable over *Heinecke*. Applicants respectfully traverse.

As presented above, *Heineck* does not teach a deposition method where two species of precursor gases are introduced into a chamber and irradiated with electromagnetic irradiation to form radical species within the chamber.

Moreover, *Heineck* in fact teaches way from the claimed invention.

As presented above, *Heinecke* discloses a method of depositing film where plasma is generated and because high energy source is required to generate plasma, a skilled artisan, upon reading *Heineck* will be discouraged from following the method of the claimed invention where radical species are generated with low energy source, such as UV light.

Accordingly, because *Heinecke* does not teach a deposition method where two species of precursor gases are introduced into a chamber and irradiated with electromagnetic

irradiation to form radical species within the chamber, and actually teaches away from claimed invention, applicants respectfully submit that the rejections on this basis are improper and should be withdrawn.

Conclusion

Based on the foregoing, Applicant respectfully submits that the application is now in condition for allowance. An early indication of the same is therefore respectfully requested. If any matters can be resolved by telephone, the Examiner is invited to call the undersigned attorney at the telephone number listed below. The Commissioner is authorized to charge any additional required fees, or credit any overpayment, to Morgan, Lewis & Bockius LLP Deposit Account No. 50-0310 (Order No. 067538-5148-US01).

Respectfully submitted,

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